EDUCATION

AND

COMPUTERS

Report No. 1

Constituting Part 2 of the January, 1957 Issue of "Computers and Automation"

COMPUTERS AND AUTOMATION

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EDUCATION AND COMPUTERS, Report No. 1

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THE EDITOR'S NOTES

EDUCATION AND COMPUTERS — II

Why say "education and computers" in one breath? Well, basically:

— "education" is the adaptation of human beings to handle information reasonably;
— "computers" is* the creation and adaptation of machines to handle information reasonably.

In January 1957 this may appear a forced parallel, a strange and unreasonable way of looking at two different fields. In the same way, two centuries ago, the parallel between human beings doing physical work and steam-powered machines doing physical work must have seemed to bystanders strange, unreasonable, forced. Even fifty years ago the automobile was greeted with the jeer, "Oh, get a horse!"

Yet the relation of education and computers was foreshadowed in the famous paper "The Education of a Computer" by Dr. Grace M. Hopper, given at the meeting of the Association for Computing Machinery, in Pittsburgh, May, 1952. Many of the stupid remarks that "computers can't think", that "computers do only what they are programmed to do", etc., lose sight of the fact that both men and computers equally have to be educated or programmed, out of a truly marvelous store of knowledge accumulated through more than 5000 years of human culture. A human being without any of the programming that he gets from school and society in his first 20 years and afterwards would be as utterly useless as a computer with no programming.

The cross-fertilization of the fields of education and computers is just beginning. One dire need — the need for more educated people in the computer field — has begun to act as a goad. This Part 2 of the January 1957 issue of "Computers and Automation" is a start of a new effort of ours to be of help in the important area of "Education and Computers".

(Note: *"Is", not "are", because the word "computers" here is being used as a singular noun meaning a field — we'd like to invent the word "computology" —, not as a plural noun meaning many machines)

THREE COMPARISONS

		Union of Soviet Socialist Republics	United States
1.	Average number of students in class per teacher	19 or 20 and decreasing	34 or 35 and increasing
		Denmark	United States
2.	Number of inhabitants for every bookseller	7,000	100,000
		No. of Vacancies	No. of Applicants
3.	In New York City on June 5, 1956, in regard to competitive examinations for candidates who are to teach mathematics in junior high schools	650	88

— reprinted from "Opportunity to Learn" in "Computers and Automation", July, 1956, vol. 5, no. 7.

EDUCATION FOR AUTOMATION

A. S. HOUSEHOLDER
Oak Ridge National Laboratory
Oak Ridge, Tenn.

Automation is bringing about the Second Industrial Revolution. We all have learned something about the dislocations which accompanied the first, as old kinds of employment disappeared and new kinds were created. In the First Revolution, the disappearance of old kinds of employment was felt most acutely. In the Second Revolution, although there is some apprehension about future unemployment, the acute shortage now and for some years to come is of people, not jobs. It is a shortage of trained professional and semi-professional workers to satisfy the mounting demands of the complex technology of the Second Industrial Revolution.

The most alarming aspect of the shortage of trained people is the incapacity of schools to prepare the rising generation to meet these new demands. The outlook for improvement is dismal. A previling philosophy displaces the traditional "three R's" in favor of "Reliability, Responsibility, and Righteousness," to quote one exponent. This philosophy has had its effect upon the teaching of students, and upon the selection, the training, and the motivation of teachers as well. While there are teachers grounded in the content of their subjects as well as in methodology, the number is few, and government and industry are attracting all but the most dedicated of these. So we cannot look to the schools alone to solve the problem of trained people. The rest of us, the nonteachers must lend a hand. The question is, what can we do and how?

Fortunately there are a number of things we can do, as will be illustrated below.

In view of the possibilities and of the need, "Computers and Automation" is instituting a new department or section of the magazine entitled "Education and Computers" or "Education for Automation". Your contributions are earnestly invited. These contributions may if you wish be in the form of letters addressed to me or to the magazine, suitable for quotation in whole or in part, telling what is being done and how it is working out, announcing what is planned and suggesting what might be done, whether by individuals, by research laboratories, or by commercial organizations. Other kinds of contributions are also invited, such as articles and papers. If you know of a project but do not have complete information, a note from you indicating a source of information will also be welcomed. In presenting this information in these pages we hope that worth-while endeavors will be copied and that promising suggestions will be picked up by those in a position to act upon them.

The average youngster probably, and certainly the superaverage youngster, has in my opinion great potentialities for self-education given the proper motivation. So it would seem that provision of motivation is the first objective. The premise is almost self-evident since many students, do at times, come to surpass their teachers. Thus the operation is not solely lifting oneself by one's own bootstraps.

Motivation can be provided in a variety of ways such as talks before student groups, exhibits, demonstrations, perhaps games and gadgets that express or illustrate a principle or way of thinking. Another way is to distribute printed material, as, for example, General Electric has done in its little brochures entitled "Why Study Mathematics?" (Available from General Electric Co., Schenectady, N. Y.)

Such projects, though directed at students, should be informative to teachers, who should be made aware of the fact that a revolution is most certainly in progress and that yesterday's coin will be short change indeed in the world of tomorrow. Perhaps some teacher can be convinced that the superior child is exceptional, too, and deserving of attention. Certainly projects designed to inform teachers and guidance counselors are in order.

These remarks are general, but we request specific information from you our readers. The General Electric brochures mentioned above were

(cont'd on page 59)

SOCIAL AND PUBLIC RELATIONS' RESPONSIBILITIES OF THE COMPUTER INDUSTRY

JAY W. FORRESTER
Division Head, Lincoln Laboratory, and
Director, Digital Computer Laboratory,
Mass. Inst. of Technology
Cambridge, Mass.

(Being the second part of the Luncheon Address given at the Eastern Joint Computer Conference, Boston, Nov. 1955; for the whole address, see the published proceedings, available from the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y.)

..... All this leads us to some of the social and public relations' responsibilities of our new and growing industry. Look around you. We recently had a series of Congressional hearings on automation by the Subcommittee on Economic Stabilization of the Congressional Joint Committee on the Economic Report. This developed from Congressional concern over the social implications of new materials and data-handling devices. Furthermore, there is a very real fear of science and technology in the minds of large segments of our population. I heard a psychologist the other day discussing some word association studies made with elementary school students. He was very distressed by the results. He found that the public, as represented by school children, associate science and scientists with such words as evil, villain, and atom bombs. These are the things that come to mind rather than the associations you would prefer.

There is need for a better public understanding of computers for many reasons. The industry itself needs more designers. It is going to need people who are able to use, to operate, and to maintain these machines. In the papers that we have heard on banking and credit card accounting, it is clear that the public needs to understand not only how some of these new methods work, why they should be used, and how they will give a better product, but people need also to understand how they must have a certain amount of forebearance and permit some changes from our present systems of accounting, billing, and sales recording.

I propose, then, that the only place that we will be able to find all of these people (the future engineers, the operators and other non-professional workers, and the public) is to go into the high schools of the country. Graduate school is much too late a time to introduce the universal field of computation into our academic institutions. It is important that undergraduates, probably in the freshman year, be introduced to the logical preciseness of digital computer programming. As an exercise in preparing complete unambiguous descriptions, programming has a universal value and is well within the grasp of the undergraduate or even the high school student. It is a misconception to believe that digital computers can be understood only by the engineers and mathematicians. I recently had an opportunity to observe an effort to find, in the Boston area, forty persons to be trained as computer programmers. We gave special attention to the basic traits required rather than to the particular branch of formal education. The work requires intelligence and logical reasoning; and for what we were doing, it seemed advisable that recruits should possess aptitude for spatial perception. Accountants, actuaries, and business administration students qualified. You might be interested in this example. One of the highest scores on the aptitude tests was made by a music major from a nearby women's college. The young lady came to work. The initial reaction in an engineering organization was one of raised eyebrows when she came around to her supervisor and asked what the words "sine" and "cos" meant. Within six weeks, however, she was making improvements in computer programs that had been worked out previously by experts. Computer programming requires interest, enthusiasm and a certain set of basic traits which don't necessarily go with any particular line of formal education.

In the next two decades, automation in the factory and electronic information processing in the office will free many men and women from their present types of work, and it will be necessary to attract many of these to the design, construction, maintenance, and management of electronic information-handling systems. We must reach into the high schools and to the public with the message that these new developments are understaffed and crying for more people rather than their being the bugaboo that will create unemployment.

Gabriel Hauge, who is economic advisor to President Eisenhower, three weeks ago in this room, gave a talk at the Boston Conference on Distribution in which he outlined the President's economic philosophy. One of the cornerstones of this philosophy is the anticipation of an expanding economy and a future shortage, rather than surplus, of labor. It is import-

ant, therefore, that devices continue to be developed to improve our productivity per man hour. If new equipment is to be fully effective, it will require better public understanding.

Now, if you don't believe that computers are of interest to the high school level, look about you. I will cite two instances that have come up recently. We have been approached by students who want to make computer exhibits for the science fairs that are held throughout the country. As you know, students build science exhibits and have competitions, and the winner of the school goes to a state fair, etc. They want computer material in the science fairs and for school assignments. I will read you a letter which came recently:

"October 3, 1955

Dean of Electronics
Massachusetts Institute of Technology

Dear sir:

I am in the eighth grade, and I am doing a report on 'Man's Thinking Machines.' I would appreciate any pamphlets, or any other information that you have on the electronic brain, or any like instruments that are thinking machines.

Thank you very much. You can send the information to: Jon Leon, 211 Pine Point Drive, Highland Park, Illinois.

One of my future ambitions is to go to M.I.T. because I want to be an engineer.

Yours truly,

Jon Leon

JL/JWL"

We had a real problem. I am at a loss to know how to answer that letter adequately. We did the best we could. We sent him information, but I don't think it was a satisfactory answer. There isn't, so far as I know, adequate material, suitably written, to answer that kind of letter. In this, the data-processing industry is lagging behind other industries. Other people are doing more.

Let me read to you from an editorial on the back of a recent investment news letter. It's a little long, but I'd like to read it all:

"THE BACK YARD

Time and again we have been reminded by educators and industrial leaders that we are not training enough new scientists and engineers to keep pace with world scientific development — But what to do about it?

Well, a significant step in the right direction has been taken by a group out in Chicago known as 'Industrial America, Inc.' They are sponsoring the distribution of American Industry Educational Hobby Kits which are produced by such well-known industrial concerns as Radio Corp. of America, Taylor Instrument Co., American Optical Co., Bauer and Black, Gemological Institute, etc.

The world famous Museum of Science and Industry in Chicago has collaborated on the design and creative side of the project and each kit contains an illustrated booklet prepared under the guidance of Encyclopedia Britannica.

Actually, these kits are scientifically planned do-it-yourself educational toys designed for the 8 to 12 - year age bracket. They pack a terrific wallop of intriguing interest to the youthful mind, and enable children to really delve into the major sciences on their own.

The electronics kit, for example, contains all the necessary parts for youngsters to learn how to transmit and receive messages on their own home-built radio sets.

With the weather kit, boys and girls can build all the instruments needed for their own complete weather station and learn how to observe and forecast weather.

The medical kit contains X-Ray Eddie, an inflatable plastic anatomical model that enables children to see how the body's blood stream, breathing, digestion, and bone structure functions. Youngsters can even take each other's blood pressure with instruments made from the kit.

Priced reasonably and available in many toy and department stores, these 'American Industry' kits should be very popular items during the coming Christmas season. Also — the scientific interest they generate may well fill our Engineering Colleges in the 1960's.

(signed) Paul Talbot

United Business Service, Boston
Weekly Bulletin
October 31, 1955"

To follow up that editorial, I went yesterday to F.A.O. Schwartz, the toy store which is three or four blocks from here, to look at such hobby kits. They are really quite impressive! They're well done! I would judge from the prices, that run around $20, that they are completely on their own financially. I think the price is a matter of importance. They are not inexpensive toys, and they are not million dollar computers. If you look at what they do in their particular fields, you find we could do the equivalent.

Since I have not run into any opposition to the importance of contacting the high school level, I expect that most of you would agree that something should be done. The problem is, what will we do to keep from

dropping the subject with everybody agreeing but nobody doing anything. I would therefore like to make a proposal that we arrange to have a team of full-time men — perhaps five or six, one donated by each of the several large industrial concerns in this field — who would work together, not as ordinary professional committee members meeting occasionally but as full-time working men with no other goals for a period of a year, and that they do this under the auspices of the Joint Computer Committee that sponsored this conference. I have not cleared this with the Committee, but I've talked to some of the members who seem to think it is a good idea. Get some people together who are interested in this educational program and give it to them as their full-time job, give them sponsorship and support from industry, and let them go to work.

The toy kits, I have mentioned (I think it is only necessary to provide material, designs and ideas and that it would be best to let somebody already in the field, like Industrial America, Inc., carry out the manufacturing and distribution). Another approach is to make arrangements with a good author who knows the high school audience level and help him to write on computers, automation, the kind of work the people will do with these machines, and the impact they will have on society — in other words, answer the questions that the youngsters are asking. There are some very good books in the science kits along this line. Also the group could encourage exhibits for our science museums. I am very sure that the science museums would enthusiastically participate if they had a little encouragement and some sources of information. Particularly, the group should plan to help the high school science teachers in various ways, (narrated film strips, experimental supplies for lab work, etc.).

I think one of the most important educational contributions would be do-it-yourself instructions that would allow the youngsters to make things representative of computers and computing circuits, and automation and controls, out of the parts that are readily available to them without expenditure for hardware. For example, supply instructions for electronic counters made of discarded radio parts. Or, the country is strewn with perfectly good relays out of automobile voltage regulators that have been discarded because the servicemen don't know how to test them. I watched a service man work on my car. He tried to adjust a 12-volt system to 7-1/2 volts by reading the 10 volt scale of a meter that he had connected to the 50 volt range — a fine set of relays to build toy computers from when he finished.......

Now, you ask how to finance such an educational program. There are many ways, but let's take the straightforward approach of considering it a normal and important part of doing business in a new field. There are about 30,000 high schools, and they have in them about 7,000,000 students. I went through a list of industrial companies last night. By picking about five companies which are predominately in the electronic data-handling field, one totals a combined yearly sales of 1.2 billion dollars. I would suggest that these companies might well afford to take one-tenth of one percent (0.1%) of sales for a joint industry educational program at the high school level. This makes a yearly budget of $1,200,000; it is $40 apiece in each high school. Compare this with the two, three, five percent, or higher, that each of these companies is spending on physical research to develop equipment to be sold to the bewildered public.

C. B. Caldwell, Vice-President of Sears, Roebuck for Personnel and Employee Relations, pointed out recently that we spend millions to eliminate friction in machines, but practically nothing to eliminate friction between people. We are talking here about eliminating friction and misunderstanding.

Touring lecturers now supplied by a few companies are not enough. They don't reach enough people nor the small places. They don't reach the rural communities. And let me point out that the rural communities are important. A recent analysis of names in "Who's Who in Engineering" was made on the basis of the percentage of each college's engineering graduates included. Colleges in the rural areas rank high. This survey showed Dartmouth at the top, second, University of Nebraska; fourth, Kansas; fifth, Missouri; ninth, South Dakota State; tenth, Missouri Mines; fifteenth, Iowa; and eighteenth, M. I. T. I think this is significant. The people that are on the country's farms are important to us in new technical fields.

You can look at the relationship of the computer field to the farm in an entirely different way. Perhaps we can help solve another problem that has been brought on by technological changes — the farm surplus problem whose solution has been sought by legislation rather than education. Fifty percent of our farms produce ninety percent of our food. That means that fifty percent of our farms produce ten percent of our food; it's the fifty percent that produce the small end that make the farm problem. The others can make a financial success of farming without controls and price supports.

Look at the relationship between the computer industry and the farm support program on a dollar basis. The computer industry — again the four, five or six companies which are major producers of computing equipment — pay about $90,000,000 a year in taxes. In federal expenditures, about one percent of the federal budget goes to the farm price support program. That means that the companies in this industry are putting one percent of $90,000,000 or $900,000 a year into the farm price support program. That is $30 per high school.

$30 to $50 per high school per year should carry a very successful program. You see, the kind of money it takes is relatively small compared with what we spend in research, compared to supporting farm programs that exist because of lack of education to lead people into other activities, compared to other public relations expenses, and indeed compared to advertising costs that try to attract engineers from the end of an educational pipeline which we are making insufficient effort to fill at its source.

HIGH SCHOOL SCIENCE EDUCATION

To: Joint Computer Committee
From: Richard W. Melville, Stanford Research Inst., Stanford, Calif.
Subject: Interim Report of the Committee on High School Science Education, November 15, 1956

Organization and Purpose

This committee was instigated as a result of the interest created by a presentation at the 1955 E. J. C. C. by Mr. J. W. Forrester. In his paper, Forrester argued that the Computer Industry has not contributed properly to the need for stirring interest in Science and Technology among the high-school age students across the country. He enumerated several areas in which public distrust or lack of information is leading young people away from scientific pursuits, and pointed out that a reversal of this trend would be most beneficial to all technical fields.

After administrative committees of the sponsoring societies of J.C.C. had met and discussed the problem, it was agreed that a committee should be organized under J. C. C. sponsorship to examine the problem in detail and make a specific proposal for future action.

Accordingly, the function was authorized and, on June 12, 1956, the writer was notified of his appointment as chairman.

Status of Past Work

During the past five months (and not on a full time basis!) the following work has been accomplished:

I. A search of available literature to try to evaluate the level of present effort in this kind of work by other groups.

A. Various groups have undertaken the job of preparing literature and text material and arranging for its publication and distribution to the schools. One such set has been prepared by RETMA covering Electricity and Electronics, Radio Servicing, etc., which have been distributed for them by McGraw-Hill. General Electric Co. has an active program of distribution of materials which they have prepared for use in the schools. General Motors has distributed this kind of material to the schools for years.

B. The Instrument Society of America is planning a "Foundation for Instrumentation Education and Research". Among their stated objectives are these two: "bringing school and college facilities up to date" and "making science more attractive to young people".

C. The Engineers' Council for Professional Development was organized in 1932 with aid to the high-school age group as its major function. This organization is presently sponsored jointly by eight of the major professional societies, including AIEE but not including IRE. (I have not been able to check the operation of this group nationally, but involved myself in their activities in the San Francisco Bay Area this fall. There was active cooperation between the Council and the school system, with time scheduled in the school program, etc. I believe that IRE should actively support this effort, and have asked Astrahan to look into the reasons why they do not do so.)

There would be a very real advantage to contracting for the services of a "Press Clipping Service" which would scan the current newspapers and periodicals for information about efforts that are being made to help out the school program. (The cost has been estimated at $30/ month.)

II. Contacts have been made locally with a number of school administrators and school science teachers to find out how they feel about this kind of a project. I have been advised by many that they are presently being flooded with suggestions and offers of help from organizations similar to the one which we are now proposing to organize. These other groups have similar motives and plan the same kind of approach to the problem that we are talking about. There seems little doubt that the only possibility of breaking into this heavy competition is dependent on our doing an exceedingly good job of preparing material for use in the schools and arranging for distribution. The teachers are interested in what we have to offer and need good material. A few are organizing electronics programs within their science courses, some have organized electronics laboratories and are beginning to tinker with gadgetry, but all are in need of projects <u>tailored to the needs of the group that they are trying to interest.</u> These projects need to be exceedingly well organized and of a tried and true nature so that they will go smoothly through the project stage in the school shops. The projects have to sell to the student on the basis of an interesting approach and the step-by-step instructions must be infallible.

An item from the Los Angeles paper late this summer described an experiment conducted at a Los Angeles high school this summer by scientists from the research laboratories of the Hughes Aircraft Company. The idea "is to interest more young persons in technical careers in engineering". The city Board of Education and the Aircraft Company both hope the program can be expanded to include all Los Angeles senior and junior high schools within a year. In addition to providing guest speakers, the Hughes Laboratories are demonstrating expensive technical equipment not usually available to schools. These lectures are part of one phase of the program; the schools in turn are sending teachers to the Hughes Laboratories for summer employment training. Ten teachers currently are doing research work at the Culver City laboratories and at the.

same time are hearing orientation lectures and taking part in discussions on scientific approaches found effective in modern day industry.

Another point that deserves consideration in our program is that of attempting to interest more of the high school girls in technical careers. The engineers have not done well with respect to the other professions. Right now, there are only three women to every 1,000 men in engineering as compared with 30 or 40 per thousand in law and medicine. It is probably true that if more talented and interested high schools were given the facts about women in engineering and the opportunities available to them, the most important step would have been taken. However, the following quotation indicates another problem area: "I spent some time in the personnel office of just about every appropriate engineering firm in a good sized eastern city and heard the phrase 'I'm sorry, we've never hired a girl engineer' many, many times. The man who needed help so badly that he was willing to take a chance on me didn't tell his boss right away that he had filled the long-vacant spot with a lady engineer."

Professor Boynton Green, recently retired from the Stanford engineering faculty, feels that the basic demand is for greater appreciation of the opportunities for youth on the part of high school teachers and councilors. "The high school attitude for a long time has been that the student must be entertained. He doesn't want to put any effort into his work and the councilor generally goes along with that idea. The student is allowed to pursue that easy-going course of study although later may well realize that had he been urged to expend a little more energy, he might have prepared himself for work in a scientific world."

The answer, at least partially, lies at the door of national professional organizations which should immediately concentrate on concrete information for high school and even grammar school councilors, he believes. Groups like the American Society for Engineering Education, of which Green is a key member in the west, must take a more active part in aiding councilors to understand the needs, preparation and rewards for prospective students, Green contends.

III. A quick search of current periodicals was made in an effort to find representative articles that would help a high school student who was trying to organize a "science project" dealing with computer type circuits.

(RN-Radio & TV News; RE-Radio & Electronics; EL-Electronics)

A. A few were found which outlined in detail a "gadget" of some sort which has a specific end use.

1. An Electronic Slide Rule RN 12/55 pg 58
   Maxine D. Kaufman W30XT
   Robert E. Gardner W30DK

   Construction details on a simple device which will multiply or divide two numbers using mechanical slide rule principles.

2. Bi-Directional Counter RE 3/55 pg 132
   from Bureau of Standards Technical News Bulletin

   Shows circuit and description of a direction sensitive electronic counter designed to keep separate counts of objects passing in two opposite directions.

B. There are many which discuss specific circuits or circuit blocks, or describe in generalized terms the operation of various kinds of computer circuitry. These articles would be of interest to a serious student, especially if he had access to an advisor who could help him through the early stages. A few samples are listed:

1. How a Computer Works RE 2/55 pg 58
   David B. Munford

   These simple Basic Circuits make it easier to understand how the more complex instruments operate.

2. Flip-Flop Counter Has Expanded Range
   EL 1/55 pg 149
   Howard Beckwith, Ch. Engr., Walkirt Co., Inglewood, Calif.

   Counter may have up to six stable states without using feedback or matrixing. Sequential operation of counter stages requires only one tube to conduct at a time resulting in greatly reduced power consumption.

3. The Electronic Decimal Counter RN 10/55 pg 60
   Edward K. Novak

   Construction details on a compact scaler incorporating a bistable multivibrator. It uses standard 12AU7 tubes.

4. Elementary Binary Arithmetic (Aerovox Research Worker 12/54)

   A brief description of the binary number system which includes a number of examples of comparative arithmetic operations carried out in the decimal and binary systems.

C. A relatively small number have been published which give details about a specific device, which, while it is complete unto itself, is intended as a building block in a system:

1. A "Universal" Counter RN 2/55 pg 54
   Louis E. Garner, Jr.

   Details on a versatile unit of many applications which features a compact battery-powered transistor amplifier.

D. The literature has many articles which describe applications of computer-type gadgetry which are interesting and instructive. In many cases the principles developed could be applied by students to demonstrations and displays. Typical examples:

1. Jukebox Ferrite Memory EL 10/55 pg 138

Describes how logical and control functions are performed with a 10 x 20 bit magnetic core memory to accomplish record selection in a Seeburg Selecto-Matic "jukebox".

2. FOSDIC - Fast Optical Sensing Device for Input to Computers

Describes a method used to produce accurate entry of information to a computer from large tally sheets used by census takers.

The greatest need is for the release of a much larger volume of simple, "one shot" devices as in paragraph A-1 above, and for some real work on compatible, building block type projects as in paragraph C above. These projects must not involve high-cost components not available to students, but must make use of common materials obtainable at low cost or better yet, no cost at all.

Future Work of this Committee

There appear to be five distinct areas within which action can be initiated immediately: These are listed below along with some of the more obvious subdivisions of each activity. It is implied that different sub-committees should be organized for each of the five.

1. Obtain funds to finance future operation. It is felt in most quarters that funds would be made available by many, if not most, of the large industries employing computer engineers, and the large manufacturers of data processing equipment. Money could be dispersed to further the following objectives and many others.

a. The implementation of Forrester's original proposal: that a working committee of 5 to 6 full time men be employed to carry out the objectives of the program and be responsible for the coordination of the many phases involved.

b. The subsidization of the cost of apparatus and materials which would be used by the schools in demonstrations, experiments, and teaching. The purpose would be to close the gap between the cost of these items, and the money available in school budgets.

c. The direct payment of administrative costs (e.g. mailing costs, periodical search service, etc.) which will be encountered by all who are involved.

2. Establish direct communication with the schools. It must be recognized at the outset that the success or failure of this whole effort hinges on the acceptance by the school authorities and the teachers responsible for science education, of the goals and motives of this committee. Good Public Relations work (see #3 below) will help, but in the long run, nearly every effort to promote science education of the high-school age group must pass through the school system filter. For this reason, it is important that the feedback loop between the schools and those interested in this work be closed at the earliest possible moment and that the channel be kept clear.

It should also be clear that coordination is required between this committee and the many other groups which have been and are being organized for the same sort of purpose in related fields. For each of these groups to approach the problem independently will produce confusion at the very level where it should be avoided most carefully. (Some evidence exists that this is already happening.)

The efforts of this sub-committee could be directed along the following lines:

a. Placement of books and pamphlets containing stimulating materials directly into the hands of science teachers and science club advisors.

b. The production of narrated film strips, motion pictures and other visual aids and their circulation.

c. Encourage, as early as the high school freshman year, the development of precise, logical thinking.

d. Encourage active, systematic organization of guided industrial plant tours for high school students. (The cooperation of the Student Activities Committees of IRE and AIEE should be secured.)

e. Science lectures and demonstrations should be organized at the local level and complete information made available to the school system so that time can be scheduled into the school program whenever a demand exists.

f. A very important function would be to help arrange for the summer employment in interesting computer industries of the teachers who desire such employment. The possibilities of this program are tremendous and the feedback of industrial enthusiasm to the student body can be very real.

g. Each year the schools have a few outstanding students that they would like to place for summer employment. The placement of the senior graduating class in industry has been much easier than placing sophomores and juniors. However, the enthusiasm which is carried away from the summer's work by a high school graduate is lost to the high school. If the lower classmen could be helped into summer employment in computer industries and laboratories their experiences would be shared by whole classes during the following year!

3. Increase the volume of published material. The first part of this work is a straightforward Public Relations

job, with two main goals: the promotion of public understanding of the functions of computers and data processing equipment and the advantage to the public of having them in use; and an educational campaign to reduce popular resentment of science and technology and the "eggheads" who work in these fields.

The second part of this job is to provide the information and know-how which will promote the understanding necessary to encourage the use of computer-type devices by as many people at as many different levels as possible.

Both of these objectives can be met by increasing the flow of material on computer technology to the established channels of publication for popular consumption.

a. Establish a clearing house for information on the ways in which computers are being used to solve everyday problems, and the new devices which are appearing regularly from laboratories all over the country. See that this information is made available to the publishers of newspapers and magazines in a form that is useful to them and their readers.

b. Contact the already established publishers in the Radio-Electronics-TV field for details of their publication arrangements, and make these facts available to the J. C. C. membership. Encourage our members to write articles for the "do-it-yourself" and "experimenter" groups and get paid for it.

c. Make an effort to get some sound text material published and distributed that can be used by student and teachers at the high school (not college) level.

4. Create a flow of computer materials from industry sources to science teachers and science club advisors for the use of groups and individual students willing to build up experimental or demonstration type equipment. To attempt worthwhile projects in the computer arts, the student must have available a selection of computer components not easily fabricated in the school shop and not available from the local radio parts supplier. Similarly, the teacher or advisor needs supplies of a type not normally accessible to him. Two obvious sources could be tapped:

a. For "standard" demonstrations, which would be repeated in many different locations, assemblies could be supplied by the major manufacturers in "package" form, as a reasonable part of their normal advertising and public relations budgets. Some will certainly be willing to supply this material if, as discussed in Section #3 above, the demand has been created and the experimental procedure outlined. Distribution should be direct from manufacturers to school, in order to encourage maximum contact.

b. If the demand can be created, the cooperation of existing distribution facilities is assured. The school laboratories are presently utilizing the facilities of the big mail order suppliers such as Allied Radio and Lafayette, and are presently purchasing heavily from manufacturers like Heath Company. If equipment and components for work in computing and data processing can be specified for them, these organizations would be glad to handle the distribution work.

c. A very large amount of material is being discarded constantly which would provide impetus to creative student work if it was made available. For instance, it is the practice of many suppliers of office machines to reduce old equipment to scrap in order to prevent its re-entrance to the machinery market. Such equipment is an excellent source of such components as key-switches, commutators, fractional horse-power motors, print heads, etc., which are absolute stumbling blocks to the youthful experimenter intent on creating some new (or old) device. It should be possible to divert some of this material to the science teacher or science club advisor for distribution without sacrificing the protection desired by the manufacturers against re-use of "brand-name defamation". It is not presently clear how this distribution could be handled, but certainly a way could be found.

5. Interest manufacturers of games and toys in the production for sale through normal channels, of gadgets and construction kits which will demonstrate computer principles, logic, etc. A very real demand exists today for relatively inexpensive assemblies which can be distributed via the organized toy market. Some are already working on this problem, but the need is for ideas and details. The mechanics of rewarding those who expend effort in this direction are firmly established, and the problem is one of matching the need of these suppliers for ideas, and the universal need of computer engineers for extra income.

a. Contact should be made with the toy manufacturers' "professional societies" such as:

The Toy Guidance Council
The Toy Information Bureau

b. Certain major distributors of toy materials would be willing to help — typical of these is the F. A. O. Schwartz Co., New York City.

c. Some manufacturers are already trying to hit this particular market. Industrial Associates, Inc., of Chicago is one of these.

Some Questions for the Joint Computer Executive Committee

When an attempt is made to implement the work of the sub-committees listed in the previous section, questions will be raised as to the acceptable techniques which can be followed. We would appreciate some direct help from the members of the executive committee on some of these points.

(cont'd on page 59)

SCIENCE EDUCATION
(cont'd from page 58)

1. Under Section 1, Obtaining Funds to Finance Future Operation, the identities of the people within computer organizations who control the expenditure of such funds are not known to us at this time. We would appreciate receiving information as to the specific name and address of each person who would be willing to concern himself with this problem within industry. An attempt would then be made to contact these individuals, supplying them with details of what we are trying to do and a tentative prospectus which would indicate the extent of our budget both in time and money. They would also be asked to supply personnel for this work if they were willing to do so.

2. Under Section 2, Establishment of Direct Communication with Schools, the question will undoubtedly be raised as to whether there is authority to hire professional consultants in the education field in order to aid in bridging this gap between our committee and the school systems. An expression of feeling would be helpful here.

3. Part of the work of Section 2, as well as that outlined in Section 3, Increasing the Volume of Published Material, will require direct contact between members of this committee and the membership of IRE, ACM and AIEE. Is there any restriction imposed on circularizing our membership? Can this be done immediately, rather than waiting for financing to be available, and if so, what arrangements can be made for mailing and distribution costs under present JCC authority?

4. The work under Section 4, Creating a Flow of Computer Materials, should be started rather soon, since it will take a long time to get such a program under way. We would appreciate as much help as we can get in trying to devise ways to organize such a program, and if anyone has thoughts along these lines, we would very much like to hear about them.

5. Members of the JCC could perform a real service by sampling their managements for personnel policies which would bear on the hiring of: a) female engineers and technicians; b) teachers and students (high school) for temporary work during the summer.

6. This committee would appreciate receiving clippings referring to science education efforts described in periodicals and newspapers from points distributed across the country. If JCC members would ask personnel in their groups to watch for these announcements, forwarding clippings or copies to the writer, it will help us to keep up to date on progress.

- END -

EDUCATION FOR AUTOMATION
(cont'd from page 51)

distributed free of charge to students and teachers. Do you know of another such? If so, what is it like, who prepared it, who puts it out, and how is it being distributed? Do you think it might have been done better? Can you report evidence as to its use and effectiveness?

Has your organization had an open house for students or teachers, or is it planning one? If so, when, and with what kind of program? If it has been done, what was the response?

Do you have a project of your own in the field of education for science or automation or computers or such, — for which you would welcome advice, publicity, support, criticism? We hope that you our readers will report, discuss, compare, and be vocal. What can you contribute?

- END -

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Editor's Note

COUNCIL FOR BASIC EDUCATION

A "Council for Basic Education" has been organized by a group of individuals who have been active in urging, through writing and speeches, increased emphasis upon fundamental intellectual disciplines in the public schools.

The Council hopes that it can help focus the scattered efforts now being made to strengthen public school education.

The founding members of the Council include: Arthur Bestor, Prof. of History, University of Illinois, and author of "Educational Wastelands"; Maynard M. Boring, Manager, Technical Personnel Division, General Electric Co., and Past President, American Society for Engineering Education; Howard A. Meyerhoff, Executive Directory, Scientific Manpower Commission, Washington, D. C.; and seven more persons.

The address is: Council for Basic Education, 20-A Union Trust Bldg., Washington 5, D. C. Inquiries are welcome.

OBJECTIVE MEASURES OF EDUCATION

DONALD TRUITT
Nelleston, Conn.

For a long time I thought that as a computer man, I did not need to be too directly concerned with the education which my children and the children of my friends were getting in the public school system of our suburban community, Nelleston. According to the grapevine where I lived, the schools in our community were "good", "among the best in the country". I could see that the school buildings were very good, some of them breath-taking in their appearance and equipment. Some teachers whom I knew, I liked and respected; I believed and still believe that very likely nearly all our teachers could teach well. Sometimes I had perplexities and doubts, but they were lulled — by soft words that "teacher knows best" and "parents should not interfere", by hope, by waiting for "readiness" and "maturation", by statements that "experiments have shown" that young people in fourth, fifth, and sixth grade should not have homework, etc., etc.

About two years ago though (April 1955), I received the shock of my life — in the area of the education which my children and other children of the community were actually receiving. The description of the shock is in Part 1 below, except that names and places have been disguised.

The disguise is in order to avoid hurting people in Nelleston, who in my opinion should not be hurt. The malfunctioning of education in Nelleston and elsewhere is not to be attributed to relatively innocent individuals locally situated, but instead to a poisonous and disastrous anti-educational system, which seems to operate to a large extent unconsciously. It is clearly a phenomenon to be studied by social anthropology. About this system I shall have more to say in another article. In the meantime readers who are interested may look in: "Educational Wastelands" by Arthur E. Bestor (The Univ. of Ill. Press, Urbana, 1953, 226 pp), "Why Johnny Can't Read" by Rudolf Flesch (Harper & Bros., New York, 222 pp; also Pocket Books), "The Crisis in Education" by Bernard Iddings Bell (McGraw Hill Book Co., New York, 1949), and related books. These books (though not without faults themselves) contain provocative facts and implications about the anti-educational system; but in my opinion the full story is more complicated, more fascinating, and perhaps more pervasively disastrous than they suggest.

In Part 2 is a brief account of my first reaction to the shock, and the questions which I put down then, for finding answers to. Since then, I have seized many opportunities to investigate, read, study, talk to people, take countermeasures in my own family, and more besides. It was revealing and stimulating to see the attention given to "education for computers" at the Eastern Joint Computer Conference in New York in December.

My main conclusion so far is that people should have "OBJECTIVE MEASURES OF EDUCATION", available in any community. They should be objective, public (nonconfidential), and understandable to anyone. The definition, description, and purpose of these measures or standards are explained more fully in Part 3 below. Such measures or standards will restore negative feedback, will restore automatic correction and control, into the educational system. Once more, control by school visiting committees will come back into local communities.

I am very sure that this is by no means all of the answer. I do know that many other computer people besides myself are intensely concerned with better education for the computer field. We can't have that without securing better education for science. And we can't have that without securing more <u>educated</u> graduates from high school.

Any suggestions, comments, or criticisms that any reader may be kind enough to send me (in care of "Computers and Automation") will be much appreciated.

1. SHOCK

April, 1955

Sam is a young man whom I know well, who is now 18-1/2, and who is graduating from Nelleston Trade and Vocational School this June. He is intelligent, active, keeps his own car, a 1941 Ford

convertible, in running order, and does most of the repairing himself. He helps at home, is friendly, open, sincere, likable, and very often forgetful. His I. Q. was determined to be 116 some years ago. His marks in trade school are one A, a set of B's, and one C; he receives B in English. One of Sam's achievements is that a year ago he borrowed a block and tackle, moved a motor from one car to another, and after he got the motor into the second car, the second car ran. His field of concentration in trade school is cabinet-making; he is good at that, and has made some fine pieces of furniture, including a cobbler's bench. He intends to volunteer for the draft, and go into the army in the autumn. Sam was never much interested in school or in studies; he began to read for his own enjoyment when he was 16-1/2. He used to listen to the radio a great deal.

Half a dozen years ago I offered Sam a prize. If he did not smoke or drink before he was eighteen, and if he would write a report — perhaps 10 pages — giving the advantages and disadvantages of drinking and smoking and telling his own decision, and the reasons for it, I would give him a prize of $100.

His eighteenth birthday came last November. The report was not done. I gave Sam $20 of the reward, since he had not smoked or drunk, and six months extension, to May 5, to write his report. During the winter, during tutoring from a friend of the family, he started working on the report, and brought me a report in the early part of April. But it did not sound like Sam, and I wondered about it. After talking it over with him, I gave him $30 more of the reward, and arranged with him to come down to my office and demonstrate in several hours there what he could do on his own.

Sam finally came to my office on Saturday, April 30. I gave him the following written-out questions to answer:

1. What are the advantages of smoking?
2. What are the disadvantages of smoking?
3. What are the advantages of drinking?
4. What are the disadvantages of drinking?
5. What is your own conclusion (decision) and why?

I told him that for the first four topics he could list the points instead of writing them out at length. I explained to him that the scoring of his answers would be based on the following points, which I wrote out, read aloud, and placed in front of him:

1. Information: completeness and accuracy; evidence of understanding.
2. Reasonableness; sensibleness; levelheadedness; good logical reasoning; common sense; honesty.
3. Presentation: English; sentence structure; choice of words; spelling; conveyance of ideas from his mind to my mind.

I told him that how much of the rest of the prize I would give him would depend on this proof of what he could do on his own.

Sam worked on his examination from 10:30 to 11:55, and then coming back after lunch, from 1:45 to 3:00. Then he stopped. I asked him if he wanted more time. He said, No, he had written as much as he could. And he left, so that he could go into town to do some shopping before stores closed.

Following is a copy of what he wrote with the spelling and punctuation of the original. The handwriting for some letters was not clear; in most cases the following typed copy gives Sam the benefit of doubts as to letters.

EXHIBIT A — SAM'S OWN REPORT

Advantages of Smooking

1. Enjoyment
2. Relaxing
3. A gráte many of my friends smoke.
4. the oppion of a grate many people which I value smoke and say it is not wronge.
5. My face would not brake out from eating chocolate.
6. If one smokes his appite will not be so great
7. I would not be as apt to bite my finger nales.
8. If I smoke I will help create jobs for outher people who manufacture cigrets matche ash trays etc.
9. I may feal psycholegical relaxed.

Disadvantages of Smoking

1. Cost
2. May cause canser
3. Burns holes in clothing
4. Burns holes in table tops and furinture
5. Messey
6. Takes a lot of your streingth away.
7. The smoke may get in your eys when driving and obstruct your vue.
8. May start fires.

9. Waste of time.
10. Stain your fingers with nicotine.
11. Ash trays have to be empted and washed.
12. Smoking stands, ash trays, matches, lighters have to be bought
13. Money saved by not smoking could be put to good use.
14. Appearance can not be as nice as it might be.
15. Bad for your teeth, may couse decay.
16. If you have become a chain smoker it is hard to brake the habit
17. It is bad for hayfever or sinaces.
18. Smels the home up.
19. Unpleasnt for outher

Advantages of Drinking

1. Enjoyment
2. Follow the croud.
3. The oppion of of people I know and value say it is not bad.
4. Many doctors perscribe it before dinner to relax the heart.
5. Doctors also perscrib it to build up an appite for thoes who need it.
6. Helps brake the ice a party which is illustrated in a pome. candy is dandy But liquer is quicker
7. Manny families drink wine with dinner every day.
8. It is polite to offer it when gests come over.
9. If it is offered to you it is polite to execept.
10. I will help create jobs for outher people
11. May help to stop minor physical discomforts such as toothache difficulty cold etc.
12. Helps to relax the nerves
13. Accepted socially.
14. If you are dipresed it will give you a lift mentally
15. I may like the taste
16. It it also good for artery trouble

Disadvantages of Drinking

1. Cost
2. One may become an alcoholic.
3. There are approximately 4,000,000 people who have troubl with drinking.
4. I may do things I wish I hadent if I get drunk
5. Breath is bad smeling
6. Makes a mess for the house wife; stains, spills
7. Have to by glasses, mixers, and pictures.
8. May loose your job.
9.

Conslusion

My conslusion is that drinking and smoking are not bad things to do. If I had a cigarete two or three time a day or a cigar now and then it wouldnt be bad. On holidays and social grathings it wouldnt hert to have cocktales. If thy are booth taken moderatly no harm can come by eather smoking or drinking.

I have desided that I want to drink and smoke. A grate many of my frinds now smoke and drink and I would like to enjoy it as they do. I thenk I will wate untile I am twentyone and then have some one show me how.

2. REACTION

April, 1955

Sam's report appalled me on two out of three counts.

Under the heading of information, Sam's report was fairly good. It showed a serious attempt to collect data. Of course, it could have included more facts.

Under the heading of English, Sam's report was appalling to me. He had never learned to listen to the sounds in the word "opinion" and the word "appetite". He could spell "physical" but could not spell "great". He was so confused about "pitchers" and "pictures", that he had written the more difficult word for the less difficult one. He could not automatically write a sentence with a subject and a predicate: "the oppion of a grate many people which I value smoke and say it is not wronge". His total output for two and a half hours was about two pages (500 words); then he had nothing more to squeeze out. For work such as this he was getting B in English. (If he was getting B, what about the others in his class?) And more besides.

Under the heading of reasonableness and logic, Sam's report was even more appalling. He had not learned to compare his own spelling of a word "conslusion" with the word written in the questions in front of him "conclusion". He had not learned to look over his own work and be consistent in his spelling: "smooking" and "smoking", "perscribe" and "perscrib". His conclusions show no weighing of reasons: after saying "one may become an alcoholic" and "4,000,000 people have trouble with drinking", he concludes he will drink, saying not one word about how he arrives at his conclusion. After referring to "canser" as a disadvantage of smoking, he does not discuss in any way how he plans or hopes to avoid it, or why he considers the risk not very important. And more besides.

After giving Sam $8 more of his reward,

(cont'd on page 63)

News Release

HUGHES TO GIVE FELLOWSHIPS
TO 200 IN SCIENCE

Culver City, Calif., September, 1956. — Hughes Aircraft Company has announced that it is awarding master of science fellowships to 200 young engineers and physicists from 36 states so they can continue their education while employed part-time at the electronics concern.

They will take advanced courses at University of Southern California, University of California at Los Angeles, or California Institute of Technology, and will be employed at Hughes in research and development laboratory work closely associated with their studies.

For the first time, Hughes officials also disclosed, additional fellowships have been established at Stanford, Purdue, and West Virginia Universities.

Hughes develops and manufactures electronic armament control systems carried by U. S. Air Force and Canadian jet interceptors, and produces the Falcon Air-to-air guided missile. It also makes cathode-ray tubes and several types of semiconductors, and is active in the fields of digital computers, ground radar, microwave devices and antennas, radomes, precision plastics, communication systems, and miniaturization.

The students, as members of the technical staff of the Hughes laboratories, will be considered professional engineers and scientists, and will receive salaries as well as payment for tuition, books and fees.

- END -

OBJECTIVE MEASURES
(cont'd from page 62)

mainly for coming down to the office and "writing his exam", I just could not give him any more.

June, 1955

Sam received his diploma from the school in June. His final mark in English was not B but C.

But, apart from the prize, the test, and the diploma, I feel so sad about Sam's equipment for his life ahead of him. The responsibility for Sam's poor equipment belongs not only to Sam, but in appropriate shares to his family, his schools, and his teachers — for example, the responsibility for the fact that he has not learned enough to look at the word "conclusion" written in the questions asked him, copy it, and therefore avoid "consluSion" in his own writing. And now it is too late for family or teachers to do much more for Sam — experience must be his teacher from now on.

The problem however is far wider than Sam. It leads to a great many questions, all derived from the incontestable result of Sam — a fine quick boy with an I. Q. of 116, and his woefully poor equipment to meet the world with.

Here are some of the questions:

— Is there any way whereby parents can compare their children year by year with appropriate objective standards that parents can understand? so that parents can see and understand what their children have accomplished and should reasonably accomplish?

— Having found out the truth about the reading, writing, spelling, and arithmetic that their children can actually produce, year by year, is there any way whereby parents can decide reasonably about <u>changes</u> to be made? <u>changes</u> in teaching, schools, tutoring, watching television, listening to the radio, guidance, instruction at home, hours for being in their rooms on school nights, etc., so as to produce better results in the education of their children? (by "objective", and "understandable" I mean "can do long division, like 3598 ÷ 36" instead of "B in arithmetic" or "grade level in arithmetic, 6.3").

— Is there any way whereby young people can be scored in school objectively, instead of receiving B in English for work as bad as this?

(cont'd on page 64)

OBJECTIVE MEASURES
(cont'd from page 63)

— How can we guide and control the factors of emotion, intelligence, capacity to work hard at studying, quality of learning and teaching, etc., to produce better results in the equipment of our children?

3. MEASURES OF DEGREE OF EDUCATION THAT ARE:
— OBJECTIVE;
— PUBLIC (NONCONFIDENTIAL);
— UNDERSTANDABLE TO ANYONE

December, 1956

The product of our schools is intended to be educated young people. They are educated through high school or secondary school when they can actually do certain objective things: read well; do arithmetic well; write English fairly well; think logically rather well; have a reasonably good knowledge of history, geography, and science; spell English adequately; and perhaps most important of all, have acquired an attitude of being interested in learning more, and know how to go about learning more, so that they can learn for the rest of their lives.

It is possible to make tests of these capacities which are objective, public (nonconfidential), and understandable to anyone. For example, a businessman when interviewing a job applicant can easily and quickly test his ability to read a paragraph, write a letter, add figures, apply a formula, spell two or three syllable words, etc.

Objective

What is an objective test? It is one in which every question has an objectively right or wrong answer, and about which 99 out of 100 informed people would agree as to the answer.

Many existing standards are not objective. Grades are not objective; different teachers and different schools mark in different ways. Diplomas are not objective; there is too much pressure upon schools to give diplomas irrespective of the quality of the student's work. The doctrine of happy adjustment in school is not objective; lots of students who, in the opinion of the teacher, are happily adjusted, are unable to read, write, and do arithmetic correctly.

Public

What is a public (nonconfidential) test? It is a test which is not confidential or restricted. It is one in which (1) before the examination, the whole subject matter of all the possible questions is openly described, is free to be published, and can be studied by anyone who cares to, and (2) after the examination, the particular questions actually asked are published or are openly stated to anyone who wishes to inquire.

Tests that are confidential or restricted are of course not open to study by anyone nor to discussion by the public. They are not sufficient for the purposes of a free society. Ordinary people using their common sense cannot correlate results on such tests with the capacity of young people to do things in the real world.

Understandable

What is a test which is understandable to anyone? It is a test in which the questions are expressed in nontechnical language, expressed in terms that businessmen, taxpapers, and most adults in the community can readily understand. A large part of such questions though perhaps not all will be based on situations that commonly occur in the daily life of the community.

Use of Such Tests

As soon as the people in a community have such tests, and knowledge of objective marks on such tests, they can start exercising intelligent control over the schools in their community. They can judge the product of the schools. They can compare the product from year to year. They can try out various methods for controlling quality of the product. They can use the successful techniques of business and industry to greatly improve the product, and the methods of production.

We can then decide year by year how schools are doing their job. We can then decide whether young people graduating from high school are in actual truth being educated adequately. "Education is everybody's business", said the 1956 White House Conference on Education. But how can we run this business if we don't have objective facts about the product?

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